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Black's Fork. The specimen apparently indicates an animal allied to the Raccoon, than which it was nearly a third smaller in size. The ramus contained a series of seven molars, immediately succeeding the canine, without hiatus. All the molars remain except the first, and this like the succeeding one was inserted by a pair of fangs.

The teeth in the specimen are much worn, so that their original character is obscure. The crowns of the premolars appear to have been nearly like those of the Raccoon. In the true molars the postero-internal cusp of the crown existing in the latter, appears to have been but feebly developed in the extinct animal.

The body of the jaw, though much shorter, is absolutely deeper than in the Raccoon. The coronoid process has been comparatively narrow; the external masseteric fossa feeble, and the condyle is remarkably small, not being more than a third in size of that of the Raccoon.

The measurements of the specimen are as follow: length from symphysis to back of condyle, 2½ inches; space occupied by the series of seven molars, 16 lines; depth of lower jaw below the first true molar, 6 lines.

For the animal the name of NOTHARCTUS TENEBROSUS was proposed.

Remains of *Palæosyops paludosus*, have since been received from Henry's Fork of Green River, Wyoming.

The following gentlemen were elected members: Chas. K. Mills, M. D.; J. Solis Cohen, M. D.; Bushrod H. James, M. D., and Mr. J. Blodget Britton.

On favorable report of the Committees, the following papers were ordered to be published:

On the Stipules of Magnolia and Liriodendron.

BY THOMAS MEEHAN.

An examination of the stipules of *Magnolia* afford some highly interesting facts; most, or perhaps all of which are known to leading botanists, but which do not appear to be as generally known as they deserve to be; and which facts may have a more intimate bearing on many of the questions connected with the laws of development than is suspected.

In most species of *Magnolia* a scar peculiar to the genus exists on the petiole. This scar is elevated somewhat above the surrounding tissue, as if the matter forming it had been laid on the surface after the rest of the petiole had been formed. The tint of green is not the same as the rest of the petiole, but it is always of the same tint as that of the leaf blade. In *Magnolia macrophylla* the petiole and under surface of the leaf is gray; the leaf blade is pale green on the upper surface. The surface of the scar is pale green, corresponding to the surface of the leaf blade. The whole appearance of the scar is such as if a portion of a leaf blade had been grafted by its under surface on the petiole.

On the upper point of the scar next the leaf blade are two small articulation points, where the membranaceous stipules finally parted from the leaf. Examining a leaf before these stipules have fallen, the main veins forming the skeleton of the stipules are found connecting with these articuli, and, spreading out, diverge downward toward the base of the leaf. In separating at maturity from the petiole, they part first from the base, and last from their place of articulation. Their weakest hold is the point farthest away from what thus appears to be their source at the apex of the scar.

Magnolia Frazeri elongates its petiole beyond the stipule several inches generally. The leaf blade then exhibits the auricle so well known in this species. The structure of this auricle is similar to the stipules in *M. macrophylla* or *M. tripetela*. The veins start out in nearly as close a fascicle as in these stipules, and they diverge and curve downwards just as these stipules do. Above these strong veins of the auricle are very weak veins, necessitating a very narrow blade portion there, until another set of strong veins push out and make the main part of the lamina.

If we press these auricles back against the petiole, and imagine an union with it, then a separation from the main leaf blade, and an union of the edges of the separated auricle, both above and below, we have a sheathed stipule exactly as we find them, and we see how easily *Magnolia Frazeri* might be a pinnate leaf of five leaflets on the supposition that the stipular portions really have taken the course we suppose these auricles might take.

I suppose no one of experience in living plants doubts the possibility of the adhesion of some parts and the separation of others, so as to make new parts or organs. If such is desired, I would refer to the *adhesion* of the carpellary leaves by their backs in the capsules of *Staphylea trifolia;* and for *separation* to the pinnate leaf often formed out of an entire blade in *Fraxinus excelsior, heterophylla*, and many other plants with entire leaves which often have pinnate ones amongst them.

It is scarcely possible, with these facts before us, to avoid the suspicion that the stipules of *Magnolia* are not formed like the stipules of most plants, which are perhaps leaf portions which have never been well developed, but rather are the tolerably well developed side pinnules of a trifoliate or deeply auricled leaf, which in an early stage had adnated with the petiole, and by their edges, and thus formed the stipular sheath we see. The suppositious case I have drawn from the auricles of *M. Frazeri* is still better illustrated by leaves of some Ranunculaceous plants. For instance, *Anemone Pennsylvanica.* Lay the lower lobes flat against the petiole, imagine the adnation by their backs, and cohesion of the edges, and we have the idea clearly.

It is difficult to conceive that these stipular sheathes could have been formed in harmony with all the appearances we have detailed, in any other way; but ideas and possibilities are not as good as direct facts. These are furnished in good part in other ways.

In the East Indian species, *M. fuscata*, the flowers are axillary, not terminal as in most other species. Three of the leaf axils on the growth of last year produce flowers. The lowest flower is the weakest, the upper the strongest. The bracts which enfold the flower buds are of course transformed leaves; and here, in these weak flowers, where the tendency of the vital course is almost as near to foliar organs as to floral parts, we find these leafy-looking bracts are trifoliate. The central lobe is composed of a short petiole, and a small oval leaf blade. Sometimes this attempt of the lower axil to produce a flower proves abortive. The already formed petals die away. In such cases the two lateral leaflets die away also, and the little miniature central leaf goes on and developes into one as large as the average on any part of the plant. But in the stronger flowers we find, just in proportion to their strength, the two lateral leaflets enlarge, and the central one diminish until at length it disappears, petiole and all. The laterals then *adhere by their edges*, become fleshy, and end in being petals. These are clearly seen to be formed out of the adnated lateral leaflets, which form the stipular sheaths in other cases, with the central of the trifoliate leaf type absorbed. This observation, in addition to the use I wish to make of it, confirms the views of some botanists, as I have learned from Professor Asa Gray, that it is by metamorphosis of the petiolar and stipular parts, rather than by modifications of the leaf blade, that petals are formed.

From these facts we gather the certainty of a trilobate type of leaf, and see the adnation of the edges; and only the dorsal adhesion to the petiole which I have shown so probable as almost to amount to a certainty, is left to be established by actual fact.

This ternate division of the leaf is a marked character in Ranunculaceæ, and with this exposition of a ternate type in Magnoliaceæ, its claim to a place in the Ranal alliance, strong as it always has been acknowledged to be, is still more strengthened.

It is impossible to suppose that a so closely allied genus as *Liriodendron* should be founded on a different type from *Magnolia*. We shall see that only very slight causes, which we can well understand, have made some of the chief foliar distinctions, and the few which we cannot prove from actual facts, can be made almost certainties from parallel observations. The identity of type will in this way be manifest.

First, as to the premorse or cut off appearance of the end of the leaf blade. This all results from the stipular portions being adnate with the stem axis, instead of being wholly on the petiole as in *Magnolia*. In the latter the stipules are carried along as the petiole advances, the leaf blade cannot grow beyond, and so in vernation has to lie flat up against them. In *Liriodendron*, the stipules being fast to the main stem, the petiole carries the leaf blade beyond them, over which it is bent until its apex is brought down in contact with the straight line formed by the union of stipule and stem. Here it is pressed as into a mould by the elongating petiole, and the form of the leaf which we see is the necessary result. These processes in *Magnolia* and *Liriodendron* can readily be seen on an examination of the buds at any time during the growing season; and to those who have no specimens the figure of the latter in Gray's Genera will easily give the idea. It may be here noted that those who look only to Mr. Darwin's principle of natural selection to account for the laws of form, might be troubled by such cases as these. It is scarcely conceivable that a square-edged leaf blade, as we find it in *Liriodendron*, is of any special benefit to the species; yet if this form is the consequence of some other act, which is a benefit, the selection principle may still hold.

If the ternate type of leaf is probable in *Liriodendron*, as in *Magnolia*, the lower portion of the petiole, and lateral or stipular portions, must have adnated with the stem prior to the full development of the leaf. This view necessitates the idea that the leaf does not always originate at the node from which it seems to spring. I do not believe it does; but I am well aware that in this I have opposed to me the weight of our best botanical authorities, from whom I would not yet dare to positively differ until I shall have the weight of more facts. I would only say that in the case of *Liriodendron* the appearances are much in favor of the belief that in an early stage the petiole clasped the stem, and for a considerable length ultimately became an integral part of its cortical system. The vessels which are seen connected in direct lines with the petioles below and above the node, as they are in existence before the leaf bud has opened, and the leaf blade has had any chance to elaborate sap from the light or air, supposed to be necessary just above before they could be formed, do not seem to originate at the node; while the fact that these vessels suddenly curve from the opposite side towards the supposed petiolar base is much more characteristic of an unfolding sheath than of a descending current of matter which would most naturally go down in a straightish line. But that the petiole has really adnated with the stem in this way in *Liriodendron* seems most probable from the fact that on the opposite side from the leaf is often seen a ridge which could hardly be formed except by the meeting of two edges enclosing a stem, with a little to spare; and at other times there is a slight depression, as if the two opposite edges barely met. There seems to be every evidence short of an actual witnessing of the fact, that the petiole in *Liriodendron* became adnate with the stem, and in this way the two lateral sections (stipules) were brought in contact with the stem with which they united. This would bring them nearer the sources of nutrition, and enable them to assume a more leaf-like and permanent character than if on the petiole. They become rather primary than secondary leaf organs, and this is just what we see them to be.

Thus we may assume that *Magnolia* has typically a ternate leaf structure; that the stipules are the two lateral lobes which by a peculiar process of adnation became stipular sheaths after having been partially organized as leaf blade; and that *Liriodendron* differs from *Magnolia* only in possessing a greater power of adnation.

Notes on SILPHIUM LACINIATUM, L.—The Compass Plant.

BY THOMAS MEEHAN.

It is at once the strength and the weakness of science that it takes little on trust. One would suppose that, after the positive facts given by President Hill in his paper before the recent meeting of the American Association, there was no room for doubt that the edges of the leaves of *Silphium laciniatum* had an average bearing north. But I find men—excellent, acute observers—who doubt the facts. They say "We took the trouble to examine the plants on the spot, and found not the slightest trace of any such tendency; we want no better evidence than that of our own senses."

As before suggested, it is an excellent habit to verify, for ourselves, the facts reported by others—there is far too little of this habit,—but when the observations conflict, it is safer to assume that both are right, and that there is something yet undiscovered which would harmonize the opposition, than that either one is wrong.

In this matter of the *Silphium* or "compass plant" I was able to find this missing link, and to see that both parties were right.

When I first saw the *Silphium*, to any great extent, in its natural localities, there was not the slightest indication of this northern tendency. It was a great surprise, as a limited knowledge of it before had taught the reverse. I determined to watch a plant carefully on my own grounds the next year. The result was just as described by President Hill. There was the unmistakable northern tendency in the leaves when they first came up, and until they were large and heavy, when winds and rains bore them in different directions, and they evidently had not the power of regaining the points lost. This often took place by their own weight alone, especially in luxuriant specimens. Mr. Hill says it was in June when he saw them on the prairies, all bearing north; when I saw them, and not doing so, it was early in September, and then no doubt the mechanical causes I have referred to, had been in operation.

The plant I have had in my garden now for some years affords much interest in many respects. I learned an useful lesson from it this year, in reference to the relative rates of growth in the different parts of the inflorescence. Noticing that there appeared to be no growth in the disk florets in the day, I determined to note accurately one morning during the last week in August, exactly when growth did commence. The ray flowers close over the disk during night, and at 4 A. M., with day just dawning in the east, I found the ray petals just commencing to open back. In the disk there are about fifteen coils of florets in the spiral. There appeared no motion until 4.40, although no doubt growth commenced at 4, when the ray petals were in motion, but too slow to be perceptible. At 4.40, however, the five outer circles were evidently slightly elevated above the others in the disk. Then follows the following record in my diary:

4.45. The five divisions of the corolla split open.

4.50. Corollas grown three thirty-seconds of an inch.

4.55. Divisions of corolla fully expanded.

5. Florets two-eighths above the rest of the disk. It might be well to say here that there was no growth in any this morning but in the five outside rows we are speaking of.

5.5, 5.10. No apparent change except that some which were not so perfectly opened as the others seemed to become so.

5.15. Pistil and mass of stamens slightly elevate above the level of the corolla.